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# DOES DEVELOPMENT FINANCE POSE AN ADDITIONAL RISK TO MONETARY POLICY?


## ABSTRACT

This study investigates whether remittances pose an extra risk to macroeconomic policy management, and the role, if any, the financial system can play in the interaction between remittances and monetary policy. We employ panel data for 106 developing countries from 1970 to 2013. Results from the Panel Vector Autoregressive (PVAR) model reveal that remittance volatility reduces macroeconomic risk in developing countries, at the same time, it stimulates a reduction in domestic interest rates. This finding remains robust to alternative specifications of remittance volatility, monetary policy risk, and to variations in the degree of financial development. The key lesson from the study is that developing countries can leverage the positive impact of remittances in reducing macroeconomic instability by implementing remittance inducing policies.



JEL classification: F33, F34, F35, O11

**Keywords:** remittances, monetary policy, developing countries, financial development, Panel Vector Auto Regression (PVAR).

## 1. INTRODUCTION

Remittances have become an important source of development finance. Thus, it is not surprising that remittances have engaged the attention of researchers, policy makers, global development financial institutions and other development partners. While policymakers continue to look to researchers for ideas to use remittances more effectively, research in this area has been clustered around the microeconomic implications of remittances (Ncube and Brixiova, 2013). These micro-level studies focus on the role of remittances in poverty reduction (Acosta et al., 2008, 2007; Adams Jr, 2004; Adams and Page, 2005; Gupta et al., 2009), child growth (Antón, 2010; Carletto et al., 2011; Mansuri, 2006), employment (Amuedo-Dorantes and Pozo, 2006; McCormick and Wahba, 2000; Taylor, 1999), and household expenditures and investment (Adams and Cuecuecha, 2010; Adams, 2006; Yang, 2008), to name a few.

Thus, a gap remains in the empirical literature regarding the macroeconomic implications of remittances. Even the limited research on the macro-level impact of remittances has focused mainly on remittances' impact on growth (Barajas et al., 2009; Chami et al., 2012; Fayissa and Nsiah, 2010; Ncube and Brixiova, 2013; Nsiah and Fayissa, 2011; Pradhan et al., 2008; Waheed, 2004). Nonetheless, for policymakers in both developing and emerging economies, gaining insight into the macroeconomic influence of remittances is fundamental for putting their countries on the path towards accelerated and pro-poor growth (Ncube and Brixiova, 2013).

In particular, the impact of remittances on monetary policy seems to have eluded the attention of empirical researchers, which has resulted in a limited understanding of the relationship between remittances and monetary policy (Vacaflores, 2012). However, economists have recently begun to test the existence of the link between remittances and monetary policy (Adenutsi and Ahortor, 2008; Chami et al., 2008; Mandelman and Zlate, 2012; Ruiz and Vargas-Silva, 2010; Vacaflores, 2012). As limited as the research in this field is, the evidence that has been uncovered has been rather contradictory. For instance, Ruiz and Vargas-Silva (2010) examine the Mexican context and find no significant relationship between remittances and domestic monetary policy, although Adenutsi and Ahortor (2008) had earlier revealed a significant relationship between monetary policy variables and remittances in Ghana.

This confusion has been exacerbated by the proposition by Ruiz & Vargas-Silva (2010: p.174) that remittances that are small relative to the size of the economy will not have an impact on monetary policy. 'If these flows are not large and/or not significant given the total size of the economy, then their impact on variables such as inflation, exchange rates and output will be minimal'. However, if the size of remittances is so important, then why would they matter to monetary policy in a small economy, such as Ghana's, in which they constitute only 0.4% of GDP and why would they be rather insignificant in Mexico where remittances add up to approximately 2.0% of GDP?

Furthermore, the previous literature on the interaction of monetary policy and remittances consists mostly of single-country studies: El-Sakka and McNabb (1999) focused on Egypt, Adenutsi and Ahortor (2008) on Ghana, Ruiz and Vargas-Silva (2010) on Mexico, and Mandelman (2013) on the Philippines. The problem with single-country studies is that they do not allow for wider applicability of the knowledge they generate. The previous literature on the subject on the whole also does not allow for the potential moderating effect of financial development in the remittance-monetary policy nexus. For instance, financial markets are known to play an intermediary function in the link between capital flows and economic growth (Agbloyor et al., 2014; Osabuohien and Efobi, 2013). However, will this moderating role hold in the case of the monetary policy-remittance link? This question is one of the unresolved issues on the topic.

Notwithstanding the perceived linkages among macroeconomic policy, remittances and the financial system, financial and development economists have been largely silent on this tripartite nexus. In our literature search in connection with this study, we have yet to encounter a study that examines the interactive effect of monetary policy and remittances on financial development and the interactive effect of remittances and the financial system on monetary policy efficiency. Thus, we have been presented with a fertile opportunity for research, and the present study exploits this opportunity and fills this void.

In this paper, we employ Panel Vector Autoregression (PVAR) to overcome endogeneity problems; to establish causality among monetary policy, remittances and other macroeconomic variables; and to generate orthogonalised impulse responses. We then use generalised impulse responses to identify the effects of remittance shocks on monetary policy. Unlike the usual Cholesky impulse responses, the use of generalised impulse responses helps us generate shocks that do not vary with the variable ordering.

We employ country-level panel data (annual) from 106 developing countries to analyse the dynamics of monetary policy decisions and remittance inflows. In the main, we investigate how remittance volatility affects monetary policy volatility. We argue that if remittances flows are indeed countercyclical to the domestic economy, then remittance volatility must be negatively related to the monetary policy rate and to monetary policy rate volatility. In addition, a contractionary domestic monetary policy must trigger a remittance inflow that is consistent with the countercyclical view of remittances. To test the first hypothesis, we compute the five-year rolling standard deviation of remittances and the monetary policy rate and model them in a PVAR framework. To test the second hypothesis, we simulate monetary contraction following the Mundell-Fleming-Dornbusch model within the framework of Cholesky innovations and orthogonalised generalised impulse response functions. In so doing, we document a significant negative relationship between remittances and remittance volatility, on one hand, and monetary policy rate and monetary policy volatility, on the other. In addition, controlling for the level of financial development and the magnitude of remittances does not nullify this relationship, thus supporting our claim that remittance volatility reduces both domestic interest rates and monetary policy risk.

Our paper contributes in a number of ways to the financial economics discipline. First, the use of PVAR helps us to analyse the dynamics of domestic monetary policy and remittances, in addition to country-specific fixed effects at the same time. Second, the use of orthogonalised impulse responses enables us to uniquely isolate the impact of shocks from each of the system variables on the other variables, one at a time.

Our paper further extends the frontiers of knowledge in financial economics by presenting new evidence showing that a contractionary domestic monetary policy will activate the inflow of remittances. We also add to those recent panel data studies that confirm a causal connection between monetary policy and remittances (see, Termos et al., 2013; Vacaflores, 2012). Although most previous studies focus on remittances and monetary policy levels, we take the step further to examine the dynamics in the volatilities of the two variables. In particular, we find that remittances and remittance volatility reduce the domestic interest rate and monetary volatility. Our results are in line with Craigwell et al. (2010) and Bugamelli and PaternÒ (2011), who find that remittances reduce receiving countries' macroeconomic risks.

Our paper also contributes to the recent debate on the intermediary function of financial development in the link between capital flows and growth (see, Giuliano and Ruiz-Arranz, 2009; Ramirez, 2013). This literature shows that remittances substitute for financial markets in economic growth when capital markets are shallow. Our results are consistent with this literature and scales up the analysis to cover how finance enhances the mitigating impact of remittances on economic policy risk.

This paper is also related to Bugamelli and PaternÒ (2011), who analyse the impact of remittances on output volatility. These authors employ an instrumental variable approach to establish causality between the two variables. Unlike Bugamelli and PaternÒ (2011), however, we explore the effects of remittances on interest rates and monetary policy risk. We argue that output is only an objective of monetary policy and that a more direct assessment of the effect of remittances on monetary conditions is therefore required. In addition, whereas Bugamelli and PaternÒ (2011) focus on remittances, we examine both remittances and remittance volatility. In terms of measurement, whereas Bugamelli and PaternÒ (2011) measure volatility in terms of deviations from the mean, we employ five-year rolling standard deviations to diminish the distortionary impact of outliers. Craigwell et al. (2010) also assess the association among remittance, output, investment and consumption volatility using a panel fixed effects methodology. However, their methodology does not allow them to generate impulse responses, which we see as critical for separating the effects of remittance shocks from shocks related to economic fundamentals. Unlike Craigwell et al. (2010) we interact remittances with financial development to assess remittances' impact on macroeconomic policy impulses. Within this framework, we uncover a potential moderating role of financial markets in reducing volatilities in both monetary policy and remittances. We are further able to simulate the influence of contractionary monetary policy on remittance behaviour.

Lastly, from a theoretical standpoint, this study lays the foundation for the development of theory on the tripartite nexus of monetary policy-remittances-financial development. Uncovering the theoretical underpinnings of this tripartite nexus will help developing countries' policymakers to devise policies that will let them get the most out of monetary policy, remittances, and financial development for socio-economic advancement. The study seeks to answer the following three main questions. (1) Do remittances pose additional macroeconomic (monetary policy) risk in developing countries? (2) Do monetary conditions

in the recipient country affect remittance inflows? (3) What role does the financial system play in the link between monetary policy and remittances?

The remainder of this paper is structured as follows. In Section 2, we specify our Panel Vector Autoregressive (PVAR) model and describe the variables used. In Section 3, we present our results and a discussion on diagnostic exercises, PVAR estimates, and the Cholesky and generalised impulse responses. Section 4 concludes the paper.

## 2. METHODOLOGICAL APPROACH

### 2.1 The Model

Economists model economic issues in multilateral interdependency settings in two main ways (Canova and Ciccarelli, 2013). The first option is to develop dynamic stochastic general equilibrium (DSGE) models. However, although well-specified DSGE models provide precise solutions to policy questions and simplify the welfare implications of economic policy (Canova and Ciccarelli, 2013), their restrictive assumptions make them largely unsuitable for analysing economic issues in a developing country context. In particular, assumptions such as optimal risk sharing, consumption smoothening, homogenous labour markets, full employment, complete markets and rationality that anchor a typical DSGE model are largely untenable in the context of developing countries (Senbeta, 2011). Moreover, certain of the restrictions of the DSGE are often not consistent with the distributional characteristics of the dataset, with the consequence that policy recommendations from such models might be misleading (Canova and Ciccarelli, 2013).

The second option is to develop Panel Vector Autoregressive (PVAR) models that avoid most of the restrictive assumptions made in the DSGE models. The PVAR advantage derives from the advantages of mother VAR models. First, all variables can be treated as endogenous, but there is also the added flexibility for including truly exogenous variables. Thus, PVARs resolve endogeneity, one of the most serious problems of econometric time series and panel data analysis. Second, PVARs facilitate the analysis of the impact of innovations, making room for interactions among variables and thus producing dynamic solutions that are not often attainable via OLS and other standard models (Li et al., 2012). The set of restrictions required in modelling dynamic interdependencies using PVARs is not so limiting as in DSGE models (Canova and Ciccarelli, 2013). Forecasts from VAR models are often more accurate than forecasts from traditional structural models. PVARs can accommodate multiple cointegration vectors, as opposed to Johansen (1988), unlike the

maximum likelihood cointegration procedure and the Johansen and Juselius (1990) test for co-integration (Ericsson and Irandoust, 2004). PVARs permit the inclusion of fixed effects that capture country-specific time-invariant effects as well as global time-invariant effects, and they can effectively handle short time dimensions due to extra degrees of freedom gained from the inclusion of cross-sections; moreover, by using impulse response functions, PVARs can show delayed effects on (and of) each variable in the system (Grossmann et al., 2014).

The PVAR model is a mixture of the conventional VAR approach – in which all variables are considered endogenous *a priori* – and the panel data approach in which unobserved individual heterogeneous effects are accommodated. The baseline PVAR model is represented below.

$$Y_{it} = B_{0i}(t) + \sum_{k=1}^{p} \alpha_{it} Y_{it-k} + u_{it} \qquad (1)$$

where $Y_{it}$ is a vector of K endogenous variables for each country, $i$=1,…, $N$ over $t$ = 1,…,$T$ time periods. In this study, $Y_{it}$ is given as:

$$Y_{it} = \begin{bmatrix} \sigma_r MPR_{it} \\ \sigma_r REMIT_{it} \\ REER_{it} \\ TRADE_{it} \\ FDI_{it} \\ LCPI_{it} \\ DCPS_{it} \\ LGDP_{it} \\ GDPg_{it} \end{bmatrix}$$

All variables are defined in Table 1. $B_{oi}(t)$ captures all deterministic components (including constants, seasonal dummies, etc.), $Y_{it-k}$ are lagged values of the endogenous variables, and $u_{it}$ is a $K$ x $1$ vector of random disturbances given by $u_{it} = [u_{1t}, u_{2t}, \dots, u_{Nt}]' \sim iid(0, \Sigma)$. $\alpha_{it}$ and $B_{oi}(t)$ are allowed to be cross-sectionally dependent. In the event that exogenous variables are present, equation (1) becomes:

$$Y_{it} = B_{0i}(t) + \sum_{k=1}^{p} \alpha_{it} Y_{it-k} + D_i(l) R_t + u_{it} \qquad (2)$$

where $D_{i,t}$ are $K$ x $M$ matrices for each lag $j$= $1$,.., $q$, and $R_{it}$ is an $M$ x $1$ vector of exogenous variables.

Equations (1) and (2) have three main distinguishing characteristics. First, they have *Dynamic Interdependencies*, which are captured by incorporating the lagged values of the endogenous variables. Second, they have *Static Interdependencies*, where $u_{it}$ are allowed to be correlated with the cross-sectional dimension *i*. *Cross-sectional Heterogeneity*, where the intercept and slope parameters and the variances of the shocks are permitted to vary across units (countries).

Alternatively, based on Love and Zicchino (2006), we might also specify the PVAR in reduced form as follows:

$$Y_{it} = \tau_0 + \sum_{k=1}^{p} \alpha_{it}\, Y_{it-k} + \tau_2 R_i + f_i + d_{c,t} + e_{it} \qquad (3)$$

The inclusion of exogenous variables ($R_i$) differentiates equation (3) above from the specification by Love and Zicchino (2006). Whereas $f_i$ captures fixed effects–country-specific unobservable time-invariant effects, $d_{c,t}$ captures country-specific time dummies that represent macro shocks specific to each country, and $\tau_o$ is a vector of constants.

**2.2 Empirical Specification of the Model**

Based on equations (1) and (2), we specify the model equations involving remittance and monetary policy in this section, as they are the two most important variables in this study. The model equations involving these two variables are specified below. Monetary policy risk can be specified as a function of the lags of endogenous variables while controlling for country-specific fixed and time specific effects as follows:

$$\sigma_r MPR_{it} = \sum_{j=1}^{p} \emptyset_{1j}\, \sigma_r MPR_{it-j} + \sum_{j=1}^{p} \emptyset_{2j}\, \sigma_r REMIT_{it-j} + \sum_{j=1}^{p} \emptyset_{3j}\, LGDP_{it-j} +$$

$$\sum_{j=1}^{p} \emptyset_{4j}\, TRADE_{it-j} + \sum_{j=1}^{p} \emptyset_{5j}\, GDPg_{it-j} + \sum_{j=1}^{p} \emptyset_{6j}\, LCPI_{it-j} + \sum_{j=1}^{p} \emptyset_{7j}\, DCPS_{it-j} +$$

$$\sum_{j=1}^{p} \emptyset_{8j}\, REER_{it-j} + \sum_{j=1}^{p} \emptyset_{9j}\, MPR.FD_{it-j} + \sum_{j=1}^{p} \emptyset_{10j}\, REMIT.FD_{it-j} + f_i + d_t + e_{it} \qquad (8)$$

$i$ is the country subscript while $t$ is a time subscript; $\sigma_r MPR_{it}$ is the monetary policy risk for country $i$ at time $t$; $\sigma_r REMIT_{it-j}$ is the lag of remittance volatility; $REER_{it-j}$ is the lag of the real effective exchange rate; $TRADE_{it-j}$ is the lag of economic openness, proxied by the share of trade in GDP; $LCPI_{it-j}$ is the lag of inflation, proxied by the logarithm of the consumer price index; $LGDP_{it-j}$ is the lag of the log of real GDP; $LGDPg_{it-j}$ is the lag of the real GDP growth rate; $DCPS_{it-j}$ is the lag of financial development, proxied by total credit provided by the financial sector as a proportion of GDP; $MPR.FD_{it-j}$ is an interaction term between monetary policy and financial development; $REMIT.FD_{it-j}$ is an interaction term between remittances and financial development; $f_i$ captures the country i-specific intercept representing country-specific fixed effects; $d_t$ captures time dummies; and $e_{it}$ is the noise error term.

Similarly, remittance volatility can be specified as the main dependent variable as follows.

$$\sigma_r REMIT_{it} = \sum_{j=1}^{p} \theta_{1j}\, \sigma_r MPR_{it-j} + \sum_{j=1}^{p} \theta_{2j}\, \sigma_r REMIT_{it-j} + \sum_{j=1}^{p} \theta_{3j}\, REER_{it-j} +$$

$$\sum_{j=1}^{p} \theta_{4j}\, TRADE_{it-j} + \sum_{j=1}^{p} \theta_{5j}\, LGDP_{it-j} + \sum_{j=1}^{p} \theta_{6j}\, GDPg_{it-j} + \sum_{j=1}^{p} \theta_{7j}\, LCPI_{it-j}$$

$$+ \sum_{j=1}^{p} \theta_{8j}\, DCPS_{it-j} + \sum_{j=1}^{p} \theta_{9j}\, MPR.FD_{it-j} + \sum_{j=1}^{p} \theta_{10j}\, REMIT.FD_{it-j} + f_i^o + d_t^o + e_{it}^o \quad (9)$$

where all variables are as defined under equation (8) above.

### 2.3 Data and Variable Selection

Apart from the monetary policy rate (MPR), which was obtained from the International Monetary Fund's (IMF) International Financial Statistics (IFS), and Monetary Freedom (MONEY_FREEDOM), which was obtained from the Heritage Foundation (HF), all other variables were sourced from the World Bank's World Development Indicators (WDI). We include 106 developing countries around the world in our sample, and these countries are listed in Table A1 in the appendix. We use an unbalanced panel (annual data) from 1970 to 2013. Two main factors informed our selection of countries for the study. First and foremost, in deciding which countries are in the 'Developing Country' category we used the

IMF and World Bank list of developing countries, which is the most widely accepted classification of countries. Secondly, for a country to be selected for the study, it must have sufficient data for the main variables for the study, including remittances, monetary policy rate and/or the lending interest, and financial development (private credit as a ratio of GDP).

The central bank's monetary policy rate (MPR) is used as the main measure of monetary policy. We use this variable because it reflects the reactions of the monetary authorities to domestic and international economic conditions. The policy rate is also considered the indicative interest rate in the domestic economy, and all other interest rates are fixed with respect to it. To capture monetary policy risk we compute the standard deviations of the policy rate *($\sigma_r MPR$)* with a five-year rolling window and also use the normal standard deviation *($\sigma_s MPR$)* (deviations from the mean) for robustness checks. Further robustness checks are conducted later using the five-year moving variance *($\sigma_r^2 MPR$)* and normal variance *($\sigma_s^2 MPR$)* in the MPR.

We measure remittances (REMIT) as the share of total international remittance inflows in GDP. Analogously, we measure remittance risk (volatility) in four similar ways – as the five-year moving standard deviation of remittances *($\sigma_r REMIT$)*, as the normal standard deviation of remittances *($\sigma_s REMIT$)*, as the five-year rolling variance of remittances *($\sigma_r^2 REMIT$)*, and as the normal variance of remittances *($\sigma_s^2 REMIT$)*. Standard deviations of remittances have been employed in previous studies by Craigwell et al. (2010) and (Bugamelli and PaternÒ, 2011).

Inflation is proxied by the log of the CPI, and the five-year rolling standard deviation of CPI is used to proxy for economic (in)stability. We use the log of GDP to measure market size and the growth rate of GDP as a measure of changes in economic fortunes (business cycle effects). The description of all of the variables, data sources and associated notations are reported in Table 1.

**Table 1: Description of Variables**

| Variable | Notation | Description | Data Source |
|---|---|---|---|
| Economic Openness | TRADE | Total trade as a ratio of GDP | WDI |
| Financial Development | DCPS | Domestic credit to the private sector as a ratio of GDP | WDI |
| Remittances (2) | LREMITT | Logarithm of total remittance receipts | WDI |
| Remittances (1) | REMIT | Personal remittances as a ratio of GDP | WDI |

| | | | |
|---|---|---|---|
| Monetary Policy Rate | MPR | The central bank's policy rate | IFS |
| Lending Interest Rate | LRATE | Logarithm of the lending interest rate | WDI |
| Inflation Rate | LCPI | Logarithm of the consumer price index (CPI) | WDI |
| Market Size | LGDP | Logarithm of Gross Domestic Product (GDP) | WDI |
| Economic Business Cycles | GDPg | Growth rate of GDP | WDI |
| Foreign Direct Investment | FDI | Foreign direct investment as a ratio of GDP | WDI |
| Macroeconomic (in)stability (1) | $\sigma_r LCPI$ | Five-year rolling standard deviation of the CPI | WDI |
| Macroeconomic (in)stability (2) | $\sigma_s LCPI$ | Standard deviation of the CPI calculated in the standard manner | WDI |
| Macroeconomic (in)stability (3) | $\sigma_r^2 LCPI$ | Five-year rolling variance of remittances as a ratio of GDP | WDI |
| Macroeconomic (in)stability (4) | $\sigma_s^2 LCPI$ | Variance of remittances as a ratio of GDP calculated in the standard manner | WDI |
| Monetary Policy Risk (1) | $\sigma_r MPR$ | Five-year rolling standard deviation of the monetary policy rate | WDI |
| Monetary Policy Risk (2) | $\sigma_s MPR$ | Standard deviation of the monetary policy rate calculated in the standard manner | WDI |
| Monetary Policy Risk (3) | $\sigma_r^2 MPR$ | Five-year rolling variance of the monetary policy rate | WDI |
| Monetary Policy Risk (4) | $\sigma_s^2 MPR$ | Variance of the monetary policy rate calculated in the standard manner | WDI |
| Monetary Policy Risk (5) | $\sigma_r^2 LRATE$ | Five-year rolling variance of the lending interest rate | WDI |
| Remittance Risk (1) | $\sigma_r REMIT$ | Five-year rolling standard deviation of remittances | WDI |
| Remittance Risk (2) | $\sigma_s REMIT$ | Standard deviation of remittances calculated in the standard manner | WDI |
| Remittance Risk (3) | $\sigma_r^2 REMIT$ | Five-year rolling variance of remittances as a ratio of GDP | WDI |
| Remittance Risk (4) | $\sigma_s^2 REMIT$ | Variance of remittances calculated in the standard manner | WDI |
| Monetary Freedom | MONEY_FREEDOM | Heritage Foundation's (HF) measure of monetary freedom | HF |
| Money Supply | LBMS | Logarithm of broad money supply as a ratio of GDP | WDI |

***Note:*** *IFS is International Financial Statistics, WDI is World Development Indicators, and HF is Heritage Foundation*

## 3. RESULTS AND DISCUSSION

Descriptive statistics are reported in Table 2. Because the mean is susceptible to distortions from outliers, we use the median of the distribution for our discussion. Median consumer inflation (CPI) is quite high (46.44), which signals high commodity prices in developing countries. The measure of the interest rate, the monetary policy rate (MPR), has a high median value, indicating the high cost of funds in the developing world. Remittances as a percentage of GDP is 1.86, which signals the increasing significance of remittances as a source of development finance in developing economies. When channelled properly, these receipts could facilitate economic development by increasing GDP growth (GDPg) above the median value of 4.28%.

**Table 2: Descriptive Statistics**

| | Mean | Median | Maximum | Minimum | Std. Dev. | Jarque-Bera | Prob | Obs |
|---|---|---|---|---|---|---|---|---|
| CPI | 48.64 | 46.44 | 288.65 | 0.00 | 37.59 | 119.66 | 0.00 | 3471 |
| DCPS | 30.06 | 23.72 | 165.72 | 0.80 | 23.89 | 6464.97 | 0.00 | 3727 |
| FDI | 3.10 | 1.62 | 53.81 | 0.06 | 5.05 | 90601.72 | 0.00 | 3608 |
| MPR | 12.62 | 8.99 | 200.00 | 0.020 | 16.33 | 111015.40 | 0.00 | 654 |
| REMIT | 4.69 | 1.86 | 106.48 | 0.00 | 9.02 | 247713.10 | 0.00 | 3197 |
| GDPg | 3.85 | 4.28 | 88.96 | -5.02E+01 | 5.84 | 69195.00 | 0.00 | 3902 |
| TRADE | 75.26 | 68.59 | 375.38 | 6.32 | 40.12 | 2080.32 | 0.00 | 3715 |

***Note 1:*** *MPR is Monetary Policy Rate; REMIT is Remittances; GDPg is Gross Domestic Product growth; CPI is Consumer Price Index; FDI is Foreign Direct Investment; TRADE is total trade; and DCPS is Domestic Credit Provided to the Private Sector.*

### 3.1 Model Selection and Estimation

The criteria for model selection is presented in Table 3. Using the model selection criteria suggested by Andrews and Lu (2001), the preferred model is a first-order panel VAR because it yields the minimum values for MBIC, MAIC and MHQ. On the basis of the results of the model selection criteria (Table 3), we fit a first-order panel VAR.

**Table 3: Selection Order Criteria**

| Lag | MBIC | MAIC | MHQ |
|---|---|---|---|
| 1 | -273.4472 | -85.9615 | -161.5667 |

| | | | |
|---|---|---|---|
| 2 | -184.3375 | -59.3469 | -109.7505 |
| 3 | -94.8601 | -32.3649 | -57.5666 |

*Note: MBIC is Modified Bayesian Criteria, MAIC is Modified Akaike Information Criteria, and MHQ is Modified Hannan-Quinn Information Criteria.*

Our PVAR models are all exactly identified, and for that reason, Hansen's J statistic of over-identifying restrictions is not computed. Monte Carlo simulation with 1000 repetitions is used to produce 5% error bands for impulse response functions.

### 3.2 Results of Panel Unit Root Test

In time series and panel data analyses, it is important to explore the order of variable integration. The stationarity status (the order of integration) of the variables helps to choose the appropriate model for estimating the coefficients. There are advantages to deploying panel unit root tests over individual time series-based unit root tests. First, panel data-based unit root tests have more statistical power than their univariate counterparts. In a panel setting, the traditional Augmented Dicky-Fuller (ADF) has low power identifying stationarity, particularly in short panels. Second, panel unit root tests are less restrictive and allow for fixed effects at the country level as well as time variations in the parameters across panels. Moreover, panel data techniques provide a suite of estimation options ranging from estimation with no trend and no constant, to estimations with a deterministic trend and a constant, and testing for common time effects. These techniques provide a high degree of flexibility in estimating parameters.

The results from Table 4 show that, apart from the Consumer Price Index (CPI), all variables are integrated of order I(0). The CPI is integrated of order I(1). In addition, the logarithmic (logs) transformation of CPI is stationary at level. We employ the logs of CPI in our estimation, which implies that all variables used for our estimations do not follow a unit root process and suggests that it is unlikely that a unique state of long-run equilibrium for the system variables exists. The results from unreported cointegration tests confirm the non-existence of a unique long-run relationship.

**Table 4: Panel Unit Root Test**

| | MPR | REMIT | LREMITT | $\sigma_s^2$REMIT | LGDP | CPI | FDI |
|---|---|---|---|---|---|---|---|
| LEVEL | | | | | | | |
| LLC | -11.00*** | 7.97*** | -10.65*** | -46.66*** | -0.49828 | 47.57*** | -11.18*** |
| IPS | -6.80*** | -4.8*** | -2.53*** | -15.64*** | 12.2972 | 54.97*** | -13.35 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ADF | 185.24*** | 330.44*** | 349.76*** | 476.36*** | 158.073 | 39.76*** | 619.74*** |
| PP | 204.75*** | 372.82*** | 342.32*** | 743.92*** | 194.544 | 37.34*** | 609.03*** |
| *FIRST DIFFERENCE* | | | | | | | |
| LLC | | | | | -33.94*** | -12.32*** | |
| IPS | | | | | -34.29*** | -14.65*** | |
| ADF | | | | | 1525.28*** | 770.79*** | |
| PP | | | | | 1529.36*** | 971.55*** | |

| | LRATE | REER | RIR | LCPI | TRADE |
|---|---|---|---|---|---|
| *LEVEL* | | | | | |
| LLC | -17646.2*** | -6.51*** | -32.34*** | -20.15*** | -3.74*** |
| IPS | -3707.32*** | -5.17*** | -28.03*** | -19.35*** | -4.87*** |
| ADF | 959.38*** | 219.44*** | 1048.70*** | 1445.44*** | 330.57*** |
| PP | 1115.92*** | 225.12*** | 1132.33*** | 1143.66*** | 337.35*** |

***Note 1:*** *LLC is Levine-Lin-Chu statistics; IPS is Im, Pesaran and Shin statistics; ADF is Augmented Dickey Fuller Fisher Chi-square statistics; PP is Phillips Perron statistics.*

***Note 2:*** *All variables are described in Table 1.*

***Note 4****: *** shows significance at the 1% level, and ** shows significance at the 5% level.*

### 3.5 Monetary Policy and Remittances

We present the results of the PVAR in Table 5. The dependent variable for Model 1 is remittance as a ratio of GDP; the dependent variable for Models 2 to 8 is the central bank's Monetary Policy Rate (MPR) used to capture the monetary policy stance and the prevailing interest rate. We include the five-year rolling standard deviation of consumer inflation instead of the CPI, as we view it as a better measure of macroeconomic (in)stability. Table 1 provides the description of variables.

*3.5.1 Macroeconomic Determinants of Remittances*

Model (1) in Table 5 reveals that financial development (DCPS) is negatively related to remittances. This finding does not necessarily imply that financial development reduces remittance inflows. We offer two interpretations. The first interpretation is that a financial sector that is not well developed obstructs the flow of remittances by increasing both the monetary and non-monetary costs of sending and receiving remittances. The second interpretation is that remittances and financial markets play substitute roles in growth, which occurs when remittance recipients rely on migrants for 'credit' instead of the local financial system. This latter interpretation concurs with Brown et al. (2013).

Remittances are largely self-driven, which is shown by the significance of the lag of remittances. Once migrants start sending money home, they have the propensity to continue sending money because they feel obliged to promote the welfare of the family and friends they left behind. In addition, monies sent back home to undertake projects are usually

delivered incrementally and not in bulk. We further find that the size of the economy positively impacts the flow of remittances. In addition, our measure of economic business cycles, growth in GDP, has an inverse relationship with the inflow of remittances supporting the countercyclical view of remittances. However, this coefficient is not significant.

Our alternative measure of foreign inflows, FDI, is negatively related to remittances, which suggests that FDI acts as an alternative source of international finance in reality. These two flows are underpinned by different characteristics, as described by Chami et al. (2008). Unlike other capital flows, remittances ignite family bonds. Second, these ignited familial relationships make remittances respond more to the needs of family members than standard private capital flows, which are largely driven by investment motives.

*3.5.1 Remittances and Monetary Policy – Dissecting the Evidence*

There is strong confirmation of a negative impact of remittances on the monetary policy rate that is evidenced by the statistical significance as well as the negative coefficient of the lag of

**Table 5: Monetary Policy and Remittances**

| | REMIT | MPR | MPR | MPR | MPR | MPR | MPR | MPR |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| REMIT(-1) | 1.0208*** | -0.1671*** | -0.1075* | -0.2456 | -0.1783*** | | | |
| | (0.0148) | (0.0572) | (0.0601) | (0.0484) | (0.0498) | | | |
| MPR(-1) | -0.0093 | 0.2364*** | 0.2235*** | 0.1906*** | 0.1748*** | 0.6806*** | 0.1330*** | 0.1872*** |
| | (0.0078) | (0.0301) | (0.0300) | (0.0256) | (0.0251) | (0.0363) | (0.0258) | (0.0253) |
| $\sigma_r LCPI$ (-1) | 0.3623 | -4.4956** | -5.5559*** | -4.1206*** | -5.3386*** | 1.7243 | -0.0510*** | 0.0005** |
| | (0.5232) | (2.0267) | (2.0303) | (1.6930) | (1.6674) | (2.0462) | (0.0158) | (0.0003) |
| DCPS(-1) | -0.3778** | -3.0653*** | -2.9369*** | -5.4937*** | -5.3942*** | -1.5309*** | -4.0263*** | -5.1504*** |
| | (0.1433) | (0.5551) | (0.5484) | (0.5244) | (0.5083) | (0.3973) | (0.5339) | (0.5107) |
| TRADE(-1) | 0.0093*** | -0.0304*** | -0.0242** | -0.0140 | -0.0065 | -0.0061 | -0.0073 | -0.0112 |
| | (0.0028) | (0.0108) | (0.0109) | (0.0092) | (0.0091) | (0.0059) | (0.0083) | (0.0087) |
| REER(-1) | -0.0005 | -0.0023 | -0.0022 | -0.0039*** | -0.0039*** | -0.0005 | -0.0042*** | -0.0042*** |
| | (0.0004) | (0.0015) | (0.0015) | (0.0013) | (0.0013) | (0.0009) | (0.0013) | (0.0014) |
| GDPg(-1) | -0.0264 | -0.0007 | -0.0519 | -0.0954 | -0.1565* | -0.0366 | -0.0337 | -0.0531 |
| | (0.0292) | (0.1129) | (0.1127) | (0.0948) | (0.0931) | (0.0605) | (0.0897) | (0.0940) |
| LGDP(-1) | 0.1109** | -0.6886*** | -0.7199*** | -0.9090*** | -0.9497*** | -0.5200*** | -0.7170*** | -0.9086*** |
| | (0.0450) | (0.1744) | (0.1721) | (0.1473) | (0.1430) | (0.0934) | (0.1465) | (0.1482) |
| FDI(-1) | -0.0716*** | -0.0767 | -0.0013 | 0.0279 | 0.1172 | 0.0080 | 0.1376* | -0.0075 |
| | (0.0243) | (0.0943) | (0.0966) | (0.0794) | (0.0801) | (0.0504) | (0.0799) | (0.0807) |
| REMIT.FD | | | -0.0597*** | | -0.0689*** | -0.01625 | -0.0477*** | 0.7545*** |
| | | | (0.0210) | | (0.0173) | (0.0109) | (0.0168) | (0.0771) |
| MPR.FD | | | | 0.7021*** | 0.7163*** | 0.2858*** | 0.5865*** | |
| | | | | (0.0718) | (0.0687) | (0.0508) | (0.0759) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\sigma_r REMIT$ | | | | | | -0.2685* | | |
| | | | | | | (0.1454) | | |
| $\sigma_s REMIT$ | | | | | | | -0.1212*** | |
| | | | | | | | (0.0508) | |
| $\sigma_s^2 REMIT$ | | | | | | | | -0.0064*** |
| | | | | | | | | (0.0019) |
| R-squared | 0.9609 | 0.4939 | 0.5115 | 0.6486 | 0.6720 | 0.8788 | 0.6705 | 0.6252 |
| Adj. R-squared | 0.9594 | 0.4735 | 0.4896 | 0.6328 | 0.6558 | 0.8725 | 0.6545 | 0.6087 |
| F-statistic | 612.1135*** | 24.2859*** | 23.3487*** | 41.1511*** | 41.3551*** | 138.4670*** | 41.8167*** | 37.8723*** |

***Note 1:*** *Remittances is the dependent variable for model (1), while the central bank's monetary policy rate is the dependent variable for models (2) to (8).*

***Note 2:*** *MPR is Monetary Policy Rate; REMIT is Remittances as a ratio of GDP; GDPg is growth rate of GDP; $\sigma_r$REMIT is five-year rolling standard deviation of remittance inflows; $\sigma_s$REMIT is the (normal) standard deviation of remittances; $\sigma_s^2$REMIT is the (normal) variance of remittances; LGDP is the log of Gross Domestic Product; $\sigma_r$LCPI is the five-year rolling standard deviation of the Consumer Price Index; FDI is Foreign Direct Investment; REER is the Real Effective Exchange Rate; TRADE is total trade as a ratio of GDP; DCPS Domestic Credit to Private Sector; REMIT.FD in an interactive term between remittances and financial development; MPR.FD is an interaction term between monetary policy (MPR) and financial development; $\sigma_r$MPR is five-year rolling standard deviation of MPR; $\sigma_s$MPR is (normal) standard deviation of MPR; and (-1) placed after a variable indicates the lag of the variable.*

***Note 2:*** ****, **, * represent significance at 1%, 5% and 10%, respectively. Figures in parentheses are standard errors.*

**Table 6: Remittance Risk and Monetary Policy Risk**

| | $\sigma_r REMIT$ | $\sigma_r MPR$ | $\sigma_r MPR$ | $\sigma_r MPR$ | $\sigma_r MPR$ | $\sigma_s MPR$ |
|---|---|---|---|---|---|---|
| $\sigma_r REMIT$ (-1) | 0.8961*** | -0.1939** | -0.1002 | -0.1923** | -0.1016 | |
| | (0.0374) | (0.0929) | (0.0921) | (0.0937) | (0.0927) | |
| $\sigma_r MPR$ (-1) | 0.0417*** | 0.0022 | 0.0106 | 0.0019 | 0.0111 | |
| | (0.0133) | (0.0331) | (0.0318) | (0.0333) | (0.0319) | |
| $\sigma_r LCPI$ (-1) | -0.7117 | 4.1068** | 2.4999 | 4.1168** | 2.4803 | |
| | (0.7613) | (1.8898) | (1.8558) | (1.8965) | (1.8639) | |
| DCPS(-1) | -0.1798** | -0.6976*** | -0.7489*** | -0.6779*** | -0.7719*** | -4.0262*** |
| | (0.0858) | (0.2131) | (0.2045) | (0.2436) | (0.2346) | (0.5339) |
| TRADE(-1) | 0.0049*** | -0.0008 | 0.0035 | -0.0008 | 0.0036 | -0.0074 |
| | (0.0016) | (0.0041) | (0.0040) | (0.0041) | (0.0041) | (0.0083) |
| REER(-1) | 2.70E-05 | -0.0012** | -0.0012* | -0.0012** | -0.0011* | -0.0042*** |
| | (0.0002) | (0.0006) | (0.0006) | (0.0006) | (0.0006) | (0.0013) |
| GDPg(-1) | -0.0077 | -0.0767* | -0.1155** | -0.0758** | -0.1167*** | -0.0337 |
| | (0.0163) | (0.0405) | (0.0399) | (0.0409) | (0.0405) | (0.0897) |
| LGDP(-1) | 0.0536** | 0.1078 | 0.0942 | 0.1079 | 0.0939 | -0.7171*** |
| | (0.0276) | (0.0685) | (0.0657) | (0.0687) | (0.0659) | (0.1465) |
| FDI(-1) | -0.0194 | -0.0187 | 0.0242 | -0.0197 | 0.0256 | 0.1376* |
| | (0.0144) | (0.0356) | (0.0358) | (0.0363) | (0.0366) | (0.0799) |
| $\sigma_s REMIT$ (-1) | | | | | | -0.1212*** |
| | | | | | | (0.051) |
| $\sigma_s MPR$ (-1) | | | | | | 0.1330*** |
| | | | | | | (0.0258) |
| $\sigma_s LCPI$ (-1) | | | | | | -0.0510*** |
| | | | | | | (0.0158) |
| REMIT.FD | | | -0.0293*** | | -0.0295*** | -0.04767*** |
| | | | (0.0075) | | (0.0075) | (0.0168) |
| MPR.FD | | | | -0.0055 | 0.0064 | 0.5865*** |
| | | | | (0.0328) | (0.0316) | (0.0759) |
| R-squared | 0.8327 | 0.2922 | 0.3545 | 0.2922 | 0.3547 | 0.6705 |
| Adj. R-squared | 0.8234 | 0.2526 | 0.3142 | 0.2481 | 0.3100 | 0.6545 |
| F-statistic | 89.0788*** | 7.3838*** | 8.7877*** | 6.6082*** | 7.9447*** | 41.8167*** |

Note 1: Refer to notes under Table 5 for the description of variables. Standard errors are in parentheses.

remittances in models 2, 3 and 5, as shown in Table 5. There are two explanations for this finding. First, an increase in remittances boosts the quantity of loanable funds available for lending in the economy, which may then lead to a decline in the interest rate. Second, when households receive remittances, their demand for formal credit will decline if the remittance received is large enough to meet their welfare and investment needs, which will cause interest rates to decline. This revelation is consistent with the prevailing wisdom based on single- and

cross-country studies. For instance, using a DSGE model, Mandelman (2013) finds that remittance inflows reduced interest rate in the Philippines. In addition, Vacaflores (2012) employs a DSGE model and comes to the same conclusion in a panel of 11 Latin American countries.

Our finding that remittances reduce domestic interest rate remains robust when remittances are measured in terms of five-year rolling standard deviation, normal standard deviation, and normal variance. This finding implies that the volatility of remittances helps to ease domestic interest conditions thereby helping to stabilise the macroeconomy. The ability of remittances to ensure output and macroeconomic stability stems from the capability of remittances to reduce volatilities in consumption and investment (Craigwell et al., 2010). We will further discuss the macroeconomic implications of remittances in the next section.

As expected, a rise in each of the following causes the policy rate to fall: financial development, real effective exchange rate, economic openness and size. This finding suggests that if developing countries can improve and sustain macroeconomic gains, they can improve the effectiveness of their monetary policies. An effective monetary policy will promote the growth and income of the populace. As the income of the citizenry rises, their demand increases for goods and services, including financial assets, which opens up more space for monetary policy management. In addition, a more favourable exchange rate is conducive for monetary policy management.

*3.5.2 Does Monetary Policy Volatility Affect Remittance Volatility?*

The volatility of monetary policy or interest rates has an adverse impact on economic growth. Therefore, central banks worldwide seek to stabilise monetary conditions to ensure macroeconomic stability. Model 1 under Table 6 shows the effect of policy rate volatility on the variation in remittance inflows. An increase in monetary policy volatility tends to decrease remittance volatility. This finding is consistent with the countercyclical properties of remittances, which are derived from the altruism theory of remittance. When macroeconomic conditions in the receiving country are unfavourable, we expect an increase in remittance inflows, and we expect the reverse when macroeconomic conditions improve. Migrants are considered sensitive to the plight of their families back home and often offer a helping hand when conditions in the home country hit their family members hard. This finding also confirms the widely held view that the macroeconomic environment in the receiving country affects migrants' remitting behaviour. The countercyclical properties of remittances have

been confirmed by Craigwell et al. (2010), Bugamelli and PaternÒ (2011), and Adenutsi (2014).

We further find that an advanced financial system reduces remittance volatility. In addition, an increase in economic openness tends to decrease the variability in remittance flows. However, as the domestic economy expands, remittance volatility also increases.

*3.5.3 Do Remittances Constitute an Additional Macroeconomic Risk?*

We report the impact of remittance uncertainty on monetary policy risk (measured as the rolling and normal standard deviation of the policy rate) in Table 6. The results from the second column to the last column are provided with monetary policy risk as the dependent variable. Remittance volatility tends to reduce monetary policy riskiness. The finding is fairly consistent in the majority of our models and is consistent with one of the established regularities in the empirical literature, that unlike other capital flows such as official development assistance, FDI and private portfolio flows, remittances are countercyclical and can act as a buffer for macroeconomic stability for that matter. By smoothening consumption, for instance, remittances help raise economic activity during hard times and reduce business cycle effects (Singer, 2010). The macroeconomic risk-mitigating impact of remittances remains robust, whether we measure remittance volatility as a five-year moving standard deviation or as normal standard deviation. Previous research on the macroeconomic implications of remittances reached similar conclusions. For instance, in a study of 69 economies, Bugamelli and PaternÒ (2011) confirm a negative link between remittances and output volatility. In addition, Craigwell et al. (2010) support the role of remittances in taming macroeconomic shocks in a panel of 95 countries. The ability of remittances to ameliorate macroeconomic risk arises from the low procyclical nature, increasing size and stability of remittances relative to other types of capital flows.

*3.5.4 Dissecting the Role of Financial Development in the Remittance-Monetary Policy Nexus*

Financial markets contribute to economic progress by enhancing efficiency and risk sharing, monitoring managerial actions to prevent fraud, harnessing and channelling savings to viable projects, and by reducing the cost of access to financing. If these properties of financial markets hold, then our financial development variable must be negatively related to the monetary policy rate or to the domestic interest rate. Table 5 shows that the financial development variable (DCPS) is consistently negative and significant for models 2, 3, 4, 5, 6

and 8, which means that a well-developed financial sector will lead to a lower monetary policy rate and hence a lower domestic interest rate. A well-developed financial system offers a wider scope for monetary policy than an immature system. This finding dovetails with the findings by Krause and Rioja (2006) that financial market development promotes monetary policy efficiency. Table 6 further shows that financial development lessens macroeconomic risk by reducing volatility in the policy rate. This result is quite robust, as it is consistent in all of the model specifications.

Additionally, the remittance-finance interactive term is significant and has a negative sign in models 3, 5, 7 and 8 in Table 5, which means that finance complements the stabilising effect of remittances on macroeconomic variables. According to Agbloyor et al. (2014) and Osabuohien and Efobi (2013), financial markets play a moderating role between capital flows and growth. In doing so, financial markets augment the positive effects of capital flows on the economy while hindering any negative impact. This finding highlights the need for policy reform in developing countries to make financial markets more efficient. The interactive term between remittances and finance is also significant in minimising macroeconomic risk (policy volatility) as shown in the results presented in Table 6. The robust nature of this finding should be of consequence to macroeconomic policy.

### 3.6 The Effects of a Contractionary Monetary Policy on Remittance Inflows

A key unresolved issue in measuring monetary shocks is the specification of a contractionary or expansionary monetary policy. Conventionally, a rise in the short-term interest rate or a fall in monetary aggregates is interpreted as a contractionary monetary policy. In this regard, the recursive Cholesky approach is used to identify monetary shocks. However, Ho and Yeh (2010) argue that this identification may be suitable only with respect to a closed economy. They argue that in a closed economy, the interest rate is the main instrument of monetary policy, such that a policy tightening may cause the short-run interest rate to fall. However, for an open economy in which there are large interventions in the forex market, a tight policy may be captured by a rise in interest rates or a reduction in foreign reserves.

A sign restriction methodology, as proposed by Uhlig (2005), can be employed to identify different contractionary monetary policy identification schemes. Alternative sign restrictions schemes have been implemented with varying degrees of success. First, Bernanke and Blinder (1992) implement a scheme that assumes that when there is a contractionary monetary shock, the short-term interest rate will not fall. Second, Gordon and Leeper (1994)

use a scheme based on the assumption that a contractionary monetary policy will not lead to a rise in monetary aggregates. A third identification scheme combines the first two. The fourth scheme views monetary contraction as innovations in both the interest rate and the exchange rate. The fifth alternative scheme captures monetary policy innovations as a decrease in money supply, an appreciation of the domestic currency, and an increase in the interest rate (Mountford, 2005). The sixth scheme posits that a tightening of monetary policy will not cause interest rates to fall or foreign reserves to rise (Ho and Yeh, 2010). Rafiq and Mallick (2008) use the seventh alternative identification scheme by employing data for three European countries, and the restrictions in this scheme are based on the standard Mundell–Fleming–Dornbusch model, which stipulates that tight monetary policy will cause interest rates to rise and the real exchange rate to appreciate, while causing prices, money supply, and real output to fall.

Ho and Yeh (2010) find that identification schemes one to five suffer from one or more of price, liquidity and/or exchange rate puzzles. The price puzzle arises when a tight monetary policy causes the price level to rise instead of causing the price level to fall. In the case of the liquidity puzzle, positive innovations in monetary policy cause interest rates to rise instead of depressing them. With the exchange rate puzzle, a tight monetary policy shock leads to a depreciation – instead of an appreciation – of the currency. Only schemes six (Ho and Yeh, 2010) and seven (Rafiq and Mallick, 2008) avoid all of the puzzles.

Based on the foregoing discussion, we follow scheme seven (the Mundell-Flemin-Dorbusch model) and specify a contractionary monetary policy as a one-unit positive shock to the interest rate (MPR), a one-unit positive shock to the exchange rate, a one-unit negative shock to inflation, a one-unit negative shock to GDP, a one-unit negative shock to money supply, and a one-unit positive shock to GDP growth. The inclusion of a shock to GDP growth is to control for supply shocks to prevent misidentification. The impulse responses from Cholesky and Generalised Impulse Responses are shown in Figure 1. The associated accumulated responses are shown in Figure 2. Both the Cholesky and the Generalised Impulse Responses in Figure 1 show that a contractionary monetary shock leads to a steady rise in remittance inflows. This finding implies that remittances can frustrate contractionary monetary policies if not properly anticipated. If properly anticipated, remittances can serve as pseudo automatic stabilisers and can substitute for monetary policy. This result is consistent with Singer (2010), who argues that in a trilemma policy framework, remittances can substitute for loss of

monetary independence based on their stabilising and countercyclical properties and allow economies to implement fixed exchange rate regimes. The results from the accumulated responses in Figure 2 are more definite. A contractionary monetary shock causes a persistent rise in remittance inflows. It is therefore safe to conclude that monetary tightening causes a rise in remittance inflows.

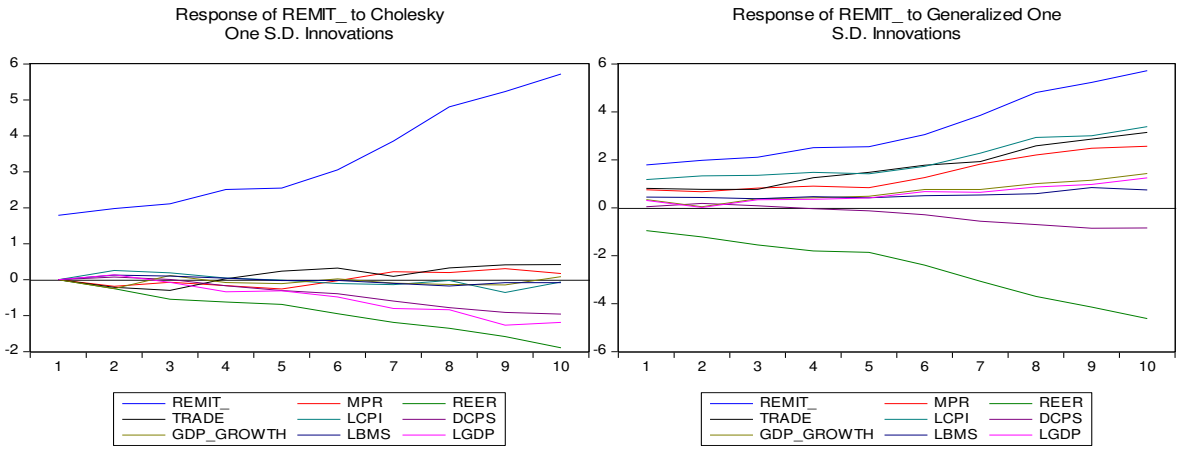


**Figure 1: Response of Remittances to Contractionary Monetary Policy**

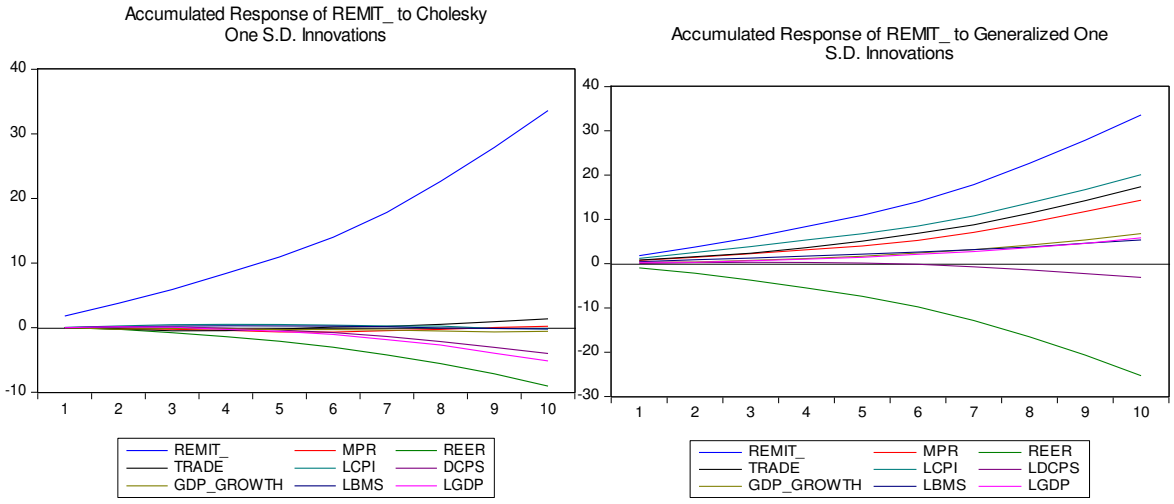


**Figure 2: Response of Remittances to Monetary Contraction – Accumulated Response**

### 3.7 Further Robustness Checks

We performed further robustness checks against measurement error and misspecification. First, instead of the monetary policy rate, we used the lending rate as an alternative proxy for monetary policy because the lending rate responds to changes in the policy rate. The

correlation between the two variables is approximately 73.54%. Second, we used the log of total remittances instead of remittances as a proportion of GDP.

**Table 7: Remittances and Monetary Policy (Lending Interest Rate)**

| | $\sigma_r^2 REMITT$ | $\sigma_r^2 LRATE$ | $\sigma_r^2 LCPI$ | TRADE | FDI | DCPS | REER | MONEY_FREEDOM |
|---|---|---|---|---|---|---|---|---|
| $\sigma_r^2 REMITT$ (-1) | 0.6066*** | -0.2957* | 4.93E-06 | -0.0304 | 0.0069 | 0.0015* | 0.0153 | -0.0266 |
| | (0.0294) | (0.1559) | (9.6E-05) | (0.0510) | (0.0255) | (0.0009) | (0.0727) | (0.0257) |
| $\sigma_r^2 LRATE$ (-1) | -0.0003 | 0.1620*** | 4.45E-06*** | -0.0003 | -0.0001 | 6.34E-06 | -0.0006 | 0.00027 |
| | (0.0004) | (0.0019) | (1.2E-06) | (0.0006) | (0.0003) | (1.1E-05) | (0.0009) | (0.0003) |
| $\sigma_r^2 LCPI$ (-1) | -3.5819 | 17.9678 | 0.8603*** | 7.4905 | -0.7893 | -0.1960 | 27.0516*** | -33.6473*** |
| | (4.6751) | (24.7993) | (0.0153) | (8.1154) | (4.0479) | (0.1374) | (11.5601) | (4.0783) |
| TRADE(-1) | 0.0183*** | 0.0139 | -8.46E-06 | 0.9749*** | 0.0074 | 0.0002 | 0.0046 | 0.0043 |
| | (0.0058) | (0.0307) | (1.9E-05) | (0.0100) | (0.0050) | (0.0002) | (0.0143) | (0.0050) |
| FDI(-1) | -0.0159 | -0.0199 | 9.26E-05 | -0.0009 | 0.58262*** | 0.0001 | 0.201052* | -0.0315 |
| | (0.0429) | (0.2275) | (0.0001) | (0.0744) | (0.0371) | (0.0013) | (0.1060) | (0.0374) |
| DCPS(-1) | -0.0119 | -0.5817 | 0.0005 | -0.4721 | -0.2016 | 0.9175*** | -0.6407 | -0.0559 |
| | (0.4401) | (2.3346) | (0.0014) | (0.7639) | (0.3811) | (0.0129) | (1.0882) | (0.3839) |
| REER(-1) | -0.0347*** | -0.0798 | -0.0001*** | 0.0098 | -0.0005 | 0.0003 | 0.8319*** | 0.00716 |
| | (0.0097) | (0.0517) | (3.2E-05) | (0.0169) | (0.0084) | (0.0004) | (0.0241) | (0.0085) |
| MONEY_FREEDOM(-1) | -0.0554 | -0.8664*** | 0.0006*** | 0.0463 | -0.0035 | -0.0004 | 0.0762 | 0.6573*** |
| | (0.0339) | (0.1801) | (0.0001) | (0.0589) | (0.0294) | (0.0010) | (0.0839) | (0.0296) |
| DREMITM | 1.5210*** | -2.9587 | -3.07E-05 | -0.1562 | 0.34435 | -0.0158 | -0.3477 | 0.4131 |
| | (0.4547) | (2.4123) | (0.0015) | (0.7894) | (0.3937) | (0.0134) | (1.1244) | (0.3968) |
| FINCDEVM | -0.9702 | -7.3643* | -0.0016 | 0.9350 | 0.5603 | 0.1056*** | 0.6661 | 0.1823 |
| | (0.7151) | (3.7933) | (0.0023) | (1.2413) | (0.6192) | (0.0210) | (1.7682) | (0.6238) |
| C | 6.6956** | 88.5848*** | -0.0349*** | -0.5903 | 1.5654 | 0.2408*** | 10.7789 | 25.4876*** |
| | (2.7809) | (14.7516) | (0.0091) | (4.8274) | (2.4079) | (0.0817) | (6.8764) | (2.4259) |
| R-squared | 0.6033 | 0.9411 | 0.9218 | 0.9628 | 0.3804 | 0.9714 | 0.7407 | 0.7804 |
| Adj. R-squared | 0.5950 | 0.9399 | 0.9201 | 0.9620 | 0.3674 | 0.9708 | 0.7352 | 0.7758 |
| Sum sq. resids | 9501.0430 | 267341.6 | 0.1018 | 28629.31 | 7122.687 | 8.2044 | 58091.36 | 7230.140 |
| S.E. equation | 4.4629 | 23.6741 | 0.0146 | 7.7472 | 3.864228 | 0.1311 | 11.0356 | 3.8933 |
| F-statistic | 72.5522 | 762.1170 | 562.0185 | 1235.067 | 29.28925 | 1620.008 | 136.2276 | 169.4904 |
| Log likelihood | -1416.839 | -2231.098 | 1375.394 | -1685.979 | -1346.539 | 304.4558 | -1858.629 | -1350.192 |
| Akaike AIC | 5.8518 | 9.18893 | -5.5918 | 6.9548 | 5.56368 | -1.2027 | 7.6624 | 5.5787 |
| Schwarz SC | 5.9463 | 9.2834 | -5.4973 | 7.0493 | 5.6581 | -1.1082 | 7.7569 | 5.6731 |

***Note:*** *$\sigma_s^2$LRATE is the five-year rolling variance of the Lending Interest Rate; REER is the Real Effective Exchange Rate; TRADE is total trade as a proportion of GDP; DCPS is Domestic Credit to Private Sector; FINCDEVM is a financial development dummy equal to 1 (high financial development) if a country's financial development exceeds the median level of financial development and zero otherwise (low financial development)*; *DREMITM is a remittance dummy equal to 1 (high remittance receiving country) when a country's remittance receipts exceed the median level and zero otherwise (low remittance receiving country); MONEY_FREEDOM is monetary freedom; and (-1) placed after a variable indicates the lag of the variable. The figures in parentheses are standard errors.*

Using the logs helps reduce variability and minimises possible heteroscedastic tendencies. Third, instead of using standard deviation we used a five-year rolling variance as a measure of risk. Fourth, we included a dummy for financial development (FINCDEVM) based on the median level of financial development. FINCDEVM equals 1 (high financial development) when a country's financial development is above the median level of financial development and zero otherwise (low financial development). In addition, we examined whether the amount of remittances received matters by including a remittance dummy (DREMITM). DREMITM equals 1 (high remittance receiving countries) when a country's remittance receipts exceed the median level and zero otherwise (low remittance receiving countries). Finally, we included a new variable, monetary freedom (MONEY_FREEDOM), to test for possible omitted variable bias. We report the results of the PVAR estimation in Table 7.

In the first column in which the variance of remittances is the dependent variable, the financial development variable (DCPS) is no longer significant after accounting for the level of financial development. However, the financial development dummy is negative and significant. This finding remains robust after controlling for the amount of remittance received. This can be explained by noting that in countries with shallow financial markets – where the cost of credit in the formal circuit is high and access is limited – households rely upon remittances as an alternative mode of finance. This understanding dovetails with our previous conclusion that remittances can serve as a substitute for bank credit when the financial system is underdeveloped. The economic openness variable (TRADE) remains positive and significant as shown earlier. The real effective exchange rate (REER) also remains significantly negative.

In the second column in which the variance of the lending rate is the dependent variable, the variance of remittances is significant and negative after accounting for the level of remittances and the level of financial advancement. This result supports the previous finding that remittances help to mitigate macroeconomic volatility. In addition, the remittance dummy is not significant, implying that the macroeconomic smoothening effect of remittances pertains in both low- and high-remittance receiving countries. From our robustness checks, we can fairly conclude that the results of this study are robust to alternative specifications of remittances, monetary policy and financial development.

## 1. CONCLUSIONS

Remittances continue to play an increasingly important role in developing countries and are becoming a dominant source of development finance, which has implications for macroeconomic policy. We find a complex web of relationships among remittances, monetary policy and financial markets. Notably, both remittances and remittance volatility tend to reduce both the monetary policy rate and monetary policy volatility. First, this finding implies that in the presence of remittances, the domestic interest rate becomes downward biased; in other words, remittance inflows will lead to favourable reductions in domestic interest rates, thereby reducing financing costs. Second, remittances are countercyclical and have a smoothening effect on macroeconomic magnitudes, which means that the presence of remittances can reduce macroeconomic fluctuations, thereby creating favourable economic conditions for the pursuit of policies that deliver shared prosperity.

This paper highlights the important role played by the financial sector in the remittance-monetary policy nexus. We find that financial development helps to reduce monetary policy risk through its interaction with remittances. This finding supports earlier studies that endorse the moderating role of financial markets in the finance-growth relationship ( see, Agbloyor et al., 2014; Osabuohien and Efobi, 2013). However, we establish a negative association between financial development and remittances. Our robustness checks help us explain this finding to mean that in countries with weak financial systems, the high cost of sending and receiving remittances obstructs remittance inflows. In addition, in undeveloped financial markets, domestic residents rely on their offshore benefactors as an alternative source of income.

Our simulation of contractionary monetary policy reveals that contractionary monetary impulses engineer a persistent inflow of remittances. We believe this finding is relevant in terms of formulating monetary policy. Central banks ought to factor this behaviour of remittances into their policy decisions and may have to think about sterilisation (when required) to achieve the desired policy outcomes.

These findings imply that one of the ways developing countries can diminish monetary policy risks is to pursue policies that facilitate remittance inflows. Such policies should be geared towards reducing the cost of sending and receiving remittances by providing innovative

financial products for remittance senders and recipients alike and by encouraging the use of formal channels for transmitting remittances.

Our findings are largely robust to an alternative specification of remittances and monetary policy, when additional explanatory variables are included and after controlling for the level of financial development and the level of remittances received.

This work corroborates earlier studies on the finance-growth nexus by Bugamelli and PaternÒ (2011) and Craigwell et al. (2010). However, although these studies establish a relationship between remittance volatility and output volatility (an indirect outcome of monetary policy), we assess the impact of remittance volatility on a direct measure of monetary policy – the monetary policy rate and its volatility.

Our paper extends the literature on international capital flows and macroeconomic stability by using a panel vector approach to establish the impact of remittance and its volatility on domestic monetary conditions. We contribute to the advancement of theory by simulating the impact of a contractionary monetary policy based on the Mundell-Fleming-Dornbush hypothesis. The impulse responses generated allowed us to understand the behaviour of remittances in the presence of domestic monetary policy shocks. In conclusion, this study, while supporting earlier findings, offers new insights into the link between migrant remittances and macroeconomic stability.

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## APPENDIX

### Table A1: List of Countries Included in the Study

| | | | | | |
|---|---|---|---|---|---|
| 1. Algeria | 21. China | 41. Guyana | 61. Moldova | 81. Samoa | 101. Uganda |
| 2. Antigua and Barbuda | 22. Colombia | 42. Honduras | 62. Mongolia | 82. Sao Tome and Principe | 102. Ukraine |
| 3. Argentina | 23. Congo Republic | 43. Hungary | 63. Morocco | 83. Senegal | 103. Vanuatu |
| 4. Armenia | 24. Costa Rica | 44. India | 64. Mozambique | 84. Seychelles | 104. Venezuela, RB |
| 5. Azerbajan | 25. Cote d'Ivoire | 45. Indonesia | 65. Namibia | 85. Sierra Leone | 105. Vietnam |
| 6. Bangladesh | 26. Croatia | 46. Iran | 66. Nepal | 86. Solomon Islands | 106. Yemen |
| 7. Barbados | 27. Djibouti | 47. Jamaica | 67. Nicaragua | 87. South Africa | |
| 8. Belarus | 28. Dominica | 48. Jordan | 68. Niger | 88. Sri Lanka | |
| 9. Belize | 29. Dominican Republic | 49. Kazakhstan | 69. Nigeria | 89. St. Lucia | |
| 10. Benin | 30. Equador | 50. Kenya | 70. Oman | 90. St. Vincent and the Grenadines | |
| 11. Bolivia | 31. Egypt | 51. Kyrgyz Republic | 71. Parkistan | 91. Sudan | |
| 12. Bosnia and Herzegovina | 32. El Salvador | 52. Lao PDR | 72. Panama | 92. Suriname | |
| 13. Botswana | 33. Ethiopia | 53. Latvia | 73. Papua New Guinea | 93. Tajikistan | |
| 14. Brazil | 34. Fiji | 54. Lesotho | 74. Paraguay | 94. Tanzania | |
| 15. Bulgaria | 35. Georgia | 55. Macedonia, FYR | 75. Peru | 95. Thailand | |
| 16. Burkina Faso | 36. Ghana | 56. Malawi | 76. Philippines | 96. Togo | |
| 17. Burundi | 37. Grenada | 57. Malaysia | 77. Poland | 97. Tonga | |
| 18. Cabo Verde | 38. Guatemala | 58. Maldives | 78. Romania | 98. Trinidad and Tobago | |
| 19. Cambodia | 39. Guinea | 59. Mali | 79. Russia | 99. Tunisia | |
| 20. Cameroon | 40. Guinea-Bissau | 60. Mexico | 80. Rwanda | 100. Turkey | |